Improving Customers Satisfaction to the Development of User Interface Design for Mobile Shopping Through QFD

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Abstract

Retailers are trying hard to develop good relationships with their customers through mobile devices (e.g., smart phone, Tablet computer, etc.). Utilizing mobile devices is a low-cost and real-time way to provide high-quality service/product for customers, which is a direct medium between retailers and end customers. However, unfriendly user interface (UI), such as small-size screen, low-resolution display, and tiny keypads, etc. hinders the development of mobile shopping. This leads to most customers are still not quite comfortable with mobile shopping (m-shopping). Most prior literatures and researches focus on how to improve customer satisfaction through UI on "website", but only few on "mobile". This paper addresses this issue by using Quality Function Deployment (QFD) to understand customers' expectations and improve their satisfaction. QFD is an effective tool to develop customers' needs and discover visual design quality elements from customers' perspectives. It also combines "the voice of the customer (VOC)" into the process of the mobile UI design. VOC and all design elements were collected from questionnaires and experts interviews. The result of this study may find out what design quality elements of UI on mobile can improve customer satisfaction when they use m-shopping. Moreover, those elements will help designers know which important elements they should be noted first. This empirically efficient instrument will be useful for designers to develop the UI on mobile and for retailers to build better relationship with customers.

Keywords: Customers Satisfaction, Mobile commerce, Mobile device, Mobile-friendly, User Interface, Quality Function Deployment, Mobile Shopping, Design

1. Introduction

1.1 Growth in mobile commerce

Today, the era of online shopping, with the progress of the device and the impact of the global business environment, retailer from electric commerce (e-commerce) to now beginning to focus on mobile commerce (m-commerce). M-commerce, namely, e-commerce activities carried out via a mobile device, such as a smartphone or PDA [1, 2]. The mobile device will become 'the access point' for all sorts of 'anytime, anywhere' services [5, 6, 7, 8]. In the several of the m-commerce, this study focused on the mobile shopping (m-shopping) which allows consumers to directly and immediately buy goods or services from a seller over the wireless technology using a mobile device.

The rapid growth of m-commerce phenomenon is also extend to Asia, both sources of innovation and economic performance are significant. For example, Taiwan's government announced enforcement NFC payments in January 2015. Telecommunications, transportation and finance will cooperate, through mobile device, user can integrate their travel card, credit card etc. This service will bring more business opportunities and potential in mobile commerce. Also, reported by the Taiwan's National Communications Commission (NCC) in 2014, development of the fourth generation (4G) of mobile telecommunications technology that people can get the faster mobile services. According to statistics, from May to October which during the few months, 4G has nearly 1.7 million subscribers, 4G innovation beyond what is expected. Therefore, we can know that the expansion of mobile population has great financial potential.

1.2 Mobile commerce is important to retailer

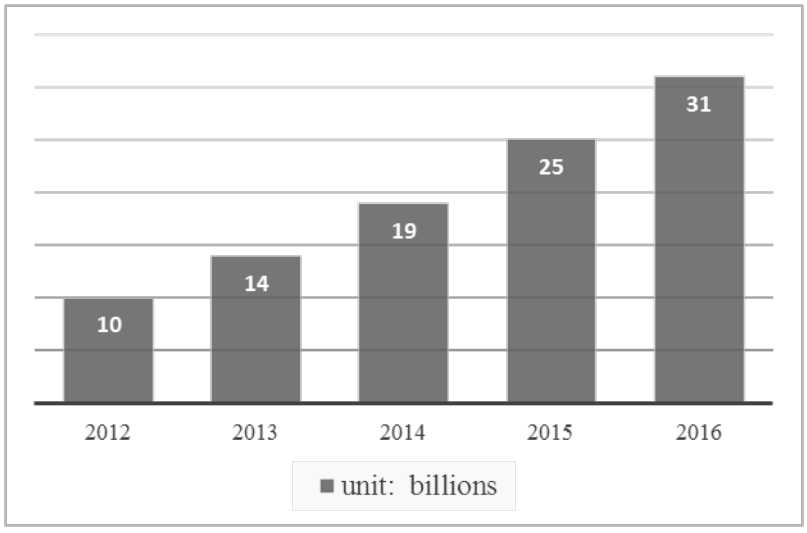
Be informed of potential in mobile commerce, led many organizations to investing substantial resources in this technology. Delivering value-added, interactive, and location-based mobile services to customers seems to be increasingly important to gaining a competitive edge by strengthening relationships with key customers [4]. There are some mean strengths to use m-commerce from Forrester, an independent technology and market research company, such as (1) Fundability, ease of finding a mobile site. (2) Utility, useful the site for shoppers. (3)Searchability, well search and search functionality. (4) Browsability, easy to browse the retailers' mobile site. (5)Buyability, easy and frictionless the buying process in on the mobile site [35].

According to the data of the EZprice, compared to Q1 and Q3 data in 2014, the total number of online stores are all growing, which Rakuten auction growth rate was the highest (16.19%), secondly is Yahoo Super Mall (15.89%), and the third for PChome Street (6.30%). Moreover, almost 1,000 stores already march into momo mall which began operating in July this year [34]. Additional of the data from internet retailer, m-commerce sales by mobile device in the US increased by 101% in the first quarter of 2014. Also the average order value on purchases through mobile device increased 12% and conversion rates increased by 29%.

For instance, the Chinese e-commerce holiday “Singles' Day” held on November 11 in China. The holiday has been capitalized by Alibaba to the tune of $5.75 billion in sales last year, according to Business Insider. Nearly eight in ten smartphone users in China surveyed by Admaster said they would be making purchases during the Double 11 online shopping festival. The number was 34 percent more than the sales in 2013. Forecasted by the Goldman Sachs, the multinational investment banking firm in American, the global m-commerce revenue reached $133 billion in 2013, and they estimate the sales will reach $626 billion in 2018. As see in Table 1, sales via mobile device will grow from $10 billion in 2012 to $31 billion in 2016, Forrester Research predicts.

Obviously, the m-commerce has a big business potential and provides an opportunity to engage with m-consumers more often and influence their behavior to purchase. It goes without saying that m-commerce played an important role in the electric business environment.

Table 1. U.S. M-Commerce Forecast, source by The Forrester Research



1.3 Important of Mobile-friendly

Even if there are lots of benefit of m-commerce, still have few things that companies should be consider. Mobile-friendly, the biggest reason to have a mobile-friendly is that a mobile-unfriendly may has chance of driving potential customers away. If want to reach customers on mobile site, retailers have to consider about how to design mobile site friendly. Reported from Google in July 2012, when customer visited a mobile-friendly site, 74% of people say they are more likely to return to that site in the future. And 67% of mobile users say that when they visit a mobile-friendly site, they're more likely to buy a site's product or service.

So that, how to make customer feel good when they skim through mobile site it's become a critical problem. Having a good mobile site is not only help companies making a few more sales, but also can building the relationship with your customer and strong brand. As we know having the mobile-friendly is important, in fast still have lots of mobile-friendliness site. Forrester surveyed 135 decision-makers to find out they have 268 websites with only 38% of their webpages mobile-friendly in 2015.

1.4 Challenges and barriers for m-commerce

Meanwhile, the m-commerce environment faces three major challenges. First, the bandwidth of the mobile internet is narrower than that of fixed lines, and the new networks occasionally disconnect without any warning. Second, compared to the desktop PCs, mobile phones have limited input buttons, displays, computing abilities, battery power, and memory. In particular, mobile phones usually are set up to move automatically into a power-off or power-save status because of the limits of their batteries, which shorten the time allowed to look for data. With smaller screens for online transactions, m-shopping require more processing pages and steps than PCs do. Finally, the environments in which m-shopping are often used are not stable enough. Unlike transactions on desktops or laptops at home or in the workplace, a mobile-phone transaction might occur in circumstances that have severe time constraints, such as while waiting for someone or while waiting for a traffic jam to clear [14]. For example, reported from e-Marketer states that only few smartphone users will buy these goods or service on their mobile devices, while 73.0% will do so via PC and 29.0% via tablet. From this we know that still few consumers accustomed to use mobile devices for online shopping.

1.5 Motivation and Study purpose

M-commerce is blossoming rapidly but it is still in its earliest state. Among the various success factors in the electric business, mobile friendly is a critical issue these

days. This paper focused on which design factor will make customer more satisfied with using mobile shopping. And, there is still less research to study what mobile-friendly design factors can improve customer satisfaction and provide a better experience to the customer. But what is needed is a much better understanding of the key factors that affect the adoption of m-commerce among customers.

In this paper, first we identify mobile friendly design elements through the `voice of the customer (VOC)' and literature reference. Then we sort the key design elements and integrating that into the development process. In the end, applying 'Quality Function Deployment (QFD)' to mobile friendly design development. Thus, our purpose was to develop the customer satisfaction for using mobile shopping. Based on our findings, can use as the reference for mobile designers or customers. Expectantly, those important factors can be improved the mobile interface quality and increased the customer satisfaction.

In this research method, "VOC" is a process to obtain the requirements from the customer which a group of users interesting in online shopping through mobile device. And initial design elements we collect through literature survey and expert interview. After obtained those items, we start analysis relationship between customers' needs and design elements. The result from those steps, we can get what is the most relative importance of the design elements. Finally, companies cloud know which elements can make their site mobile-friendly.

2. Literature Review

2.1 The popularization of Mobile Commerce

Mobile Commerce (M-commerce) refers to "any transaction, involving the transfer of ownership or rights to use goods and services, which is initiated and/or completed by using mobiles access to computer-mediated networks with the help of mobile devices"[3]. And usually, m-commerce is a support mechanism that provides mobile information and promotion [16].M-commerce impact on businesses have been profound. Examples include banking, investing, auctions, shopping, and mobile phone service [15]. In recent reported from StatCounter, the independent website analytics company, in September 2014, showed that the use of mobile devices to access the internet has increased by 67% worldwide over the last 12 months. This trend is significant growth in Taiwan, according to data of Institute for Information Industry (III) FIND in 2014, people aged 12 (or more) that the current smart phone user has been as high as 58.7% of the population; in the past six months, the Taiwanese

smartphone penetration grew by 51.4% to 58.7%. As shown in table 2, accordance with current trends, the popularity of smart phones in Taiwan situation will gradually mature stage, is expected to enter the market saturation period in 2016.

Also, Google released the global consumer insight in October 2014 report that Taiwan ranked first in the world purchasing power of action. More than 50% of consumers use mobile shopping (m-shopping), ahead of the United States, Japan and other countries. More consumers now attach to m-shopping and their expectations are getting higher. It promote to improve the level of the relation between retailers and customers by exchanging the information among them. As a result, m-shopping is a key enabler of retailers deliver their services to customers.

Table 2. 2010-2016f Taiwan smartphone penetration trend

Year	**Penetration (%)**	**Collocation population (K)**
2011H1	12.9	1,382
2011H2	18.2	1,850
2012H1	26.2	2,126
2012H2	35.4	3,275
2013H1	43.1	3,934
2013H2	51.4	4,898
2014H1	58.7	5,301
2014H2	65.4	6,043
2015f	71.4	14,799
2016f	76.3	15,798

Source: Institute for Information Industry FIND 2014

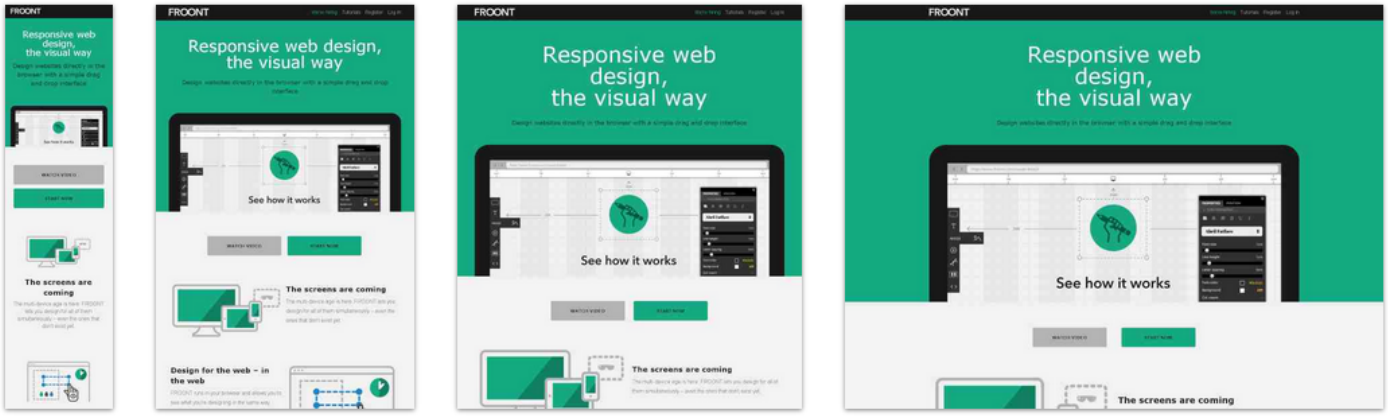
2.2 Mobile-friendly site

As stated by Write Techie, "*a mobile friendly site is a website in which the content is rendered in a manner that is easily readable for mobile devices, such as smart phones and tablet devices. That said, it must include similar features found on a standard website, such as navigation, search options, and share functions*."[36]

Mobile-friendly now is become the potential leads, because research has found that

67% of people are more likely to make a purchase from a website that is mobile friendly [37]. For example, the good mobile site design can across multiple screen such as Figure 1.

Figure 1. Mobile-friendly Website



Source: FROONT, is a web-based design tool that runs in the browser and makes responsive web design.www.froont.com

According to Google in 2014, a website must include the following features to be classified as "mobile friendly" by their Googlebots: (1) *it avoids software that is not common on mobile devices (like Flash)*, (2) *Uses text that is readable without zooming*, (3) *Sizes content to the screen so users don't have to scroll horizontally or zoom*, and (4) Places links far enough apart so that the correct on can be easily *tapped.*

In Taiwan, the 87% smart phone users will search for products/services through their mobile phones [17]. Mobile device is an indispensable tool for businesses (including the building relationship with customers, finding potential customers), is the future trend. Therefore, to ensure every customer have a good experience that navigate your site through mobile device.

2.3 User interface quality and customer satisfaction

Despite Taiwan has more than half of consumers use m-shopping, however, compared to 42.9% PC shopping satisfaction, but only 15.4% of consumers are satisfied with the m-shopping experience [17]. So that there are still potential of the interface for m-shopping to develop.

Interface design quality is an area of research that examines how information is displayed [18]. In m-shopping, an interface is often the first connection point. It is therefore important that the good interface is presented, as users will form their

impressions based on this initial information [19]. Numerous studies have assessed such factors as display formats, colors, and graphs versus tables and how these factors affect customer satisfaction [20]. Moreover, all those measure can be directly influencing the Representation of information quality from the way of present that information within application [21]. In addition, there are three principles that need to be followed in designing user interface: 1) let the users be in control of the interface, 2) reduce user's memory load, and 3) make the user interface consistent [22]. To develop effective m-shopping interfaces, this paper chose the seven design elements of the customer interface (7Cs) from Rayport and Jaworski (2001), because they provide a full view framework for analyzing m-shopping interfaces. According to the 7Cs, a customer interface in e-commerce is including context, content, community, customization, communication, connection, and commerce [23].

In addition, Lee & Benbasat (2003) have implemented the 7C's framework to mobile interface. They make the framework more fixable to work within mobile environment. To do this, we can be implemented in developing mobile interface for m-shopping.

2.4 Quality function deployment

QFD was born in this environment as a method or concept for new product development under the umbrella of Total Quality Control. The subtitle "An Approach to Total Quality Control" added to Quality Function Deployment [24]. Professor Yoshizawa mentioned that the significance of QFD in industry, QFD has provided a communication tool to designers. Engineers, positioned midway between the market and production, need to lead new product development. QFD renders a powerful arm to engineers as they build a system for product development [25]. As shown in Table 3, although QFD has been combined with many new ideas, it has rarely been applied in studies related to m-shopping. M-Shopping has already been rapid and has great potential, therefore we can apply QFD into m-shopping to improve user interface quality and consumer satisfaction.

The first phase of QFD, usually called house of quality (HOQ), is of fundamental and strategic importance in the QFD system [27]. Use the HOQ to understand the voice of the customer and to translate it into the voice of the engineer. Subsequent houses continue to deploy the voice of the customer through to parts characteristics, key process operations, and production requirements [26]. In many different products, HOQ methods can be created by practitioners and applied to the products, because each HOQ models can have individual results of key elements to survey the applicable outcomes [27].

Table 3. Using QFD in different regions during the past 10 years

Authors and the Publish Years	Research Region	Brief description
Lin, 2006	Service quality of hot-spring hotels	Combine QFD's house of quality to put customer care needs into internal process design of hot-spring hotels key operational technology for management in response to important items of quality needs worthy of high priorities, in order to make sure the services provided meet customers' needs and to shorten the distance between customers and service providers.
Ben Clegg, Boon Tan, 2007	Micro-sized enterprise	To show how QFD can be used as part of a structured planning and analysis framework for micro-sized enterprises to build-up their e-business capabilities.
Sangeeta, Sahney, 2008	Online retailing	Based on literature, use QFD to outline the results General online retailing and identify the critical factors for success in online retailing.
Kuo and Chen, 2009	Quality of shopping website designs	Suggestions for improving the quality of website design, used QFD to enhance the competitiveness of their websites in the highly competitive online shopping market.
Sun, Liu, 2010	Improvement of business software process	Proposed SPI framework based on the CMMI using QFD aims to achieve objectives. To develop a method based on QFD for the integration and prioritization of requirements from multiple perspectives.
Zareia, Fakhrzadb, Paghaleh, 2011	Improvement of food supply chain	Used QFD to identify viable Lean Enablers to be practically implemented in order to increase the leanness of the food chain.
Na, Xiaofei,Yang, Ming, 2012	Service quality of power supply	Employing QFD concept on power supply quality appraisal. Results show that which needed to be improved on the first priority, and is consequently helpful for management decision making.
Kamvysia, Gotzamania,	Education – Improvement	Use of an alternative framework for prioritizing students' requirements within QFD. The

Andronikidisb, Georgiouc, 2014	course design	proposed framework is assessed in capturing and prioritizing students' requirements regarding courses' learning outcomes within the process of an academic course design.

3. Research Methodology

In this study, we propose to development customer satisfied with user interface in mobile commerce. First, we should understand the customer needs. After identify customer quality needs, using QFD methodology can find quality elements, and then verify the relationship between customer needs and quality elements. Finally, the application of QFD can satisfy the over-growing need for high quality, m-shopping interface design. Following is our five research steps for the m-shopping interface design model:

3.1 Identify m-customers' quality needs – QFD "WHATs"

This study was focused on consumers who often use mobile devices. We used two stages to collect the customer quality needs.

First we focus group of m-customers interview were performed to identify their needs. In this sampling stage, target m-customers are selected by the researcher in order to acquire necessary and required information. In the interview, a total of 15 m-shopping users (The age between 21 to 25 years old, on average, with 4 to 6 years of experience in using mobile to surf the information) were asked their requirements of mobile store. After the research, we were conducted to attain a preliminary understanding of customer quality needs. The relative information about customer needs acquired from the interviews, then after analyzed entirely and converted into customer quality needs for m-store.

Then, we use the questionnaire which designed based on the interviews to get information about m-customer importance of needs and literature review. The thirteen most important needs were finally selected are listed in Table 4.

After needs items stemming from customers, the KJ method was used to be sorted those items into groups, based on their similar contents or characteristics, for review and analysis. Those items can classify into three major groups: functionality, information and appearance (Seen in Table 5).

Table 4. Quality needs of m-consumers

Search the product	Review previous search	Product compare
Check out	Product selection	Clear page design
Understandable terminologies	Product categories	Spam commercial
Clear introduction about the product	Attractive layout design	Product appearance
Understandable navigation icon		

Below, we state major groups "what's" that we have identified:

- *Functionality*: Is fairly important for the design of m-store, is often called "the key of successful for the mobile website". It's mean every component of site should work quickly and lightly. It is what helps users navigate through the site, use the site features, and find the information they are looking for. A functional mobile website is one where designers estimate the needs of users, and where users can easily find what they need.
- *Information:* In addition to providing simple and fast services, giving users the information they want is also quite important. Mobile website not only provides information, or the information is not coherent or up-to-date, but gives customers "right" information. Users expect integrity service from mobile sites, we have given the correctly information and services what they need.
- *Appearance:* It's the first contact with the customer. A site contains attractive visual effects, it can expressing your products and services. And it can impress and keep visitors on your site once they arrive. i.e., Good use of color, font size for paragraph text between 10 and 12 pts and keep it simple and allow for adequate white space. Don't overload your site with overly complex design. However, you must attract and keep your customers' attention, compared to other competitor's website.

Table 5. Quality needs of m-consumers after used KJ method

Tier one	Tier two
Functionality	*Easy to search the product*
	Easy to review previous search
	Easy to product compare
	Easy to check out
	Easy product selection
Information	*Clear introduction about the product*
	Understandable terminologies
	Easy to find product categories
	Spam commercial
Appearance	*Clear page design*
	Attractive layout design
	Product appearance
	Understandable navigation icon

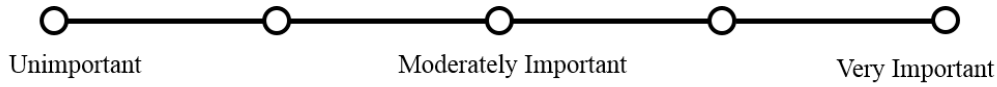
3.2 Ratings of m-customers' needs

This step use 5-point Likert scale (figure 2) was used for scoring satisfaction and importance. The scaled from extremely unimportant to extremely important (1 to 5) to measure the degree of importance of each customer needs. Then weighting the customer wants estimated by averaging the scores rated. For each m-customers' demands, the average relative importance rating (Wi) is computed by

$$Wi = \sum_{k=1}^{k} gik \ \div \ k \, , i = 1 \ldots . . M$$

Which M is number of customer needs, gik is score of importance rating and k is the total number of responses.

Figure 2. 5-point Likert scale



3.3 Ex*tracting interface design* quality elements – QFD "HOWs"

The first step is to confirm that the customer needs, and this step is based on m-store design and needs to develop and communicate the needs of the customer, and to achieve customer needs and improve their satisfaction.

Through *expert interviews* method, discuss with two software engineers and a consultant, and finally get 14 design elements. Then we analyze and classify the customer needs and similar design elements, the development of these interfaces to communicate with each design element / functional requirements to meet customer needs. The 14 design elements classified into three groups (Seen in Table 6): usability, content and aesthetic. Following is we identified the key features related to mobile websites:

- *Usability:* According to George (2004), in the Web context, the term usability [28] covers aspects that influence a site's ease of use, navigability, consistency of functionality across pages etc. [29]. This attribute is highly valued by users, as it ensures that they can actually use the "product". Given the great number of web sites that a user may visit even daily, the demand for effective usability is higher for WWW user interfaces than for normal user interfaces [29]. In addition, a usable site is one where the user can easily find what he is looking for, no-matter how deep and broad the content is, and is supported by the existence of an efficient search mechanism, although we cannot simply rely on search as the main navigation feature. Navigational structure and overviews are necessary to avoid user confusion and should be provided both in the large (server structure and location) and

in the small (structure for the individual pages with iconic markers for the various types of information) [29].

- *Content:* Bill Gates (1996) declared "CONTENT IS KING"! This phrase is mean that internet marketers have to denote the importance of a website's content from the customers' views. Content is the reason that people visit your website. But many software developers excessive emphasis on create the prettiest page and ignore the content. What good content is? i.e., to creating good content for your website is to be sure that your content will have specific appeal to your target audience. [31] Also create content use simply words and articles about product is in, this ensures that your visitors can understand clearly. On a final note, always try to update your content people will become regular visitors and will be exposed to the products and services you offer. This is turn will equal more sales and profit.[31]
- *Aesthetic:* The importance of aesthetics in website design and its effect on users' impressions. An effective response to the website's aesthetics may improve consumers' mood and their overall evaluations of the website. Also researches showed that the aesthetic value of a product pertains to the pleasure derived from seeing the product, without consideration of utility [32]. In HCI literature, it has been suggested that "beautiful is usable" in website design [33]. Therefore, aesthetic is an important architectural dimension for websites since it enhances a customer's pleasure as they browse and find relevant information, and consumers are likely to return to a website if it provides an interesting and entertaining interface experience [32].

Table 6. Quality needs of m-consumers after used KJ method

Tier one	Tier two
Usability	*Independent input box*
	One-click checkout
	Multiple payment methods
	Auto fill function
Content	*Detail Product information*

	Interactive Links (YouTube, Facebook etc.)
	Text simple and easily readable
	Easy sharing to social media
	Clarity of options
Aesthetic	*Simple/Clear m-shopping design*
	Product full views (365 ° views)
	Sliding image to view the info.
	Enable pinching to zoom
	Each page limit the number of menu

3.4 Create HOQ table－Relationship between "HOWs" and "WHATs"

To make each design element, corresponding to the needs of each customer attributes, we need to consider the design elements meet the properties of customer needs. This step requires an experienced software engineer based on their expertise and experience to develop the mobile website, and cooperate with each other in order to achieve the customer needs, then consensus between requirements and design. For the relationship between each design elements and the customers' needs, to indicate the degree of strengths of relations between them, we defined a four level rating scale "0 = non relationship, 1 = weak relationship, 5 = medium relationship, 9 = strong relationship."

For example (Table 7), the rating scale can also presented in symbols (◎ strong =9 ,○ medium = 5,△ weak = 1). In HOQ matrix is can apparent a strong, medium and weak relationship between "How's "and "What's".

Table 7. A typical HOQ matrix

		Design quality elements			
		H1	H2	H3	H4
M-customer Needs "VOC"	W1	◎			
	W2	△	○	△	○
	W3	○	△	◎	△
	W4		◎		○

This matrix is represent the relationship between "WHATs" and "HOWs", and get an entire identification and prioritization. Thus, HOQ offers the advantage of easier ways to transition between the voice of customer and engineer.

3.5 Ratings of design quality elements

This step we calculates the absolute importance for each design element. The accuracy of the results will be affected the relationship matrix, matrix of consistency and quality is very important. For example, the absolute importance (HA_j) of design quality element (H_j) can know via the computing paradigm by

$$HA_j = \sum_{i=1}^{D} W_i R_{ij} \ , \qquad D \geq 1$$

Which m-customers' needs importance degrees (W_i) multiply by matrix relationship weight (R_{ij}) and D is number of design quality elements. And for relative important (HR_j) (meaning about to standardize), the following formulations were used:

$$HR_j = HA_j \div \sum_{i=1}^{D} HA_i \ , \qquad D \geq 1$$

For example, the relative important of design quality elements "*clarity of options"* is 13.74 %, this data is important to its initial weight by 6.85 divided by the sum of 49.86. This result also may be used on site functionality or customer needs. The last presentation of the data relative weight percentages, so that mobile developers/m-marketers can grasp the key design elements and customer needs.

4. Conclusion

M-commerce is beneficial for businesses. It provide the close communication and convenient add-value services for customers. So through M-commerce can make business scale gets large and wild range of market place. This paper aims to examine

the factors in design mobile-friendly sites that affect the customer satisfaction of shopping through mobile device. Furthermore, the goal of this study is to identify customer requirements and find the relative design elements that affect the mobile user experience. According to pervious study, the mobile sites with good user friendly interface can make customer easier to understand, provide good quality of service and make work more efficiently etc.

In order to improve user interface design quality, this study use QFD methodology. And according to the completed HOQ, we sorted the importance of design elements and the top five are: (1) One-click checkout, (2) Simple/Clear interface design and (3) Sliding image to view the information (4) Clarity of options, (5) Number of menu display. Therefore, when engineers design the mobile interface have to notice those items.

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